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Tests Of A Sprinkler System For HOT-WEATHER HAULING OF LIVE HOGS In Truck-Trailers

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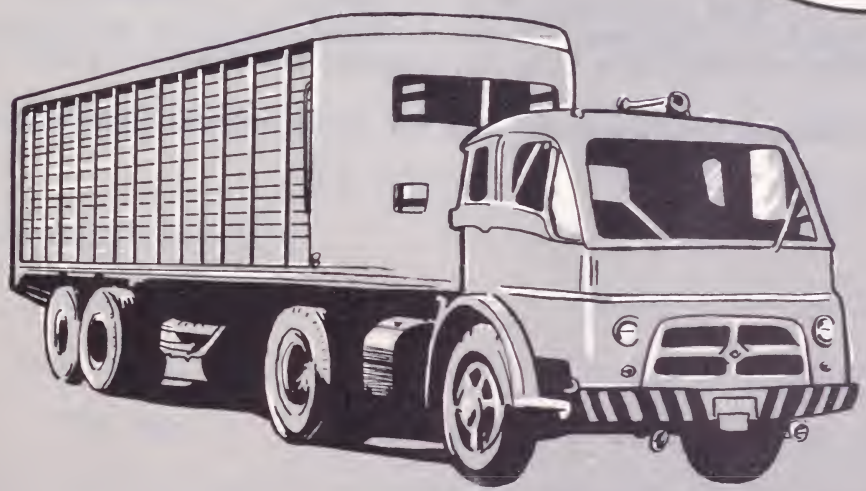
An Interim Report



Marketing Research Report No. 172

Agricultural Marketing Service
Marketing Research Division
UNITED STATES DEPARTMENT OF AGRICULTURE

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Credit is also due the truck drivers for their helpful participation in the project.

May 1957

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SUMMARY

In an effort to reduce death losses and in-transit shrinkage of hogs during hot weather, a hog marketing company in Smithfield, N. C., in 1955 installed a simple and inexpensive water sprinkler cooling system in its truck-trailers used to haul live hogs. The system was made of ½-inch galvanized pipe, standard pipe fittings, and a length of garden hose. It cost, installed, about $75 per trailer. To determine whether and to what extent this system was effective, the Agricultural Marketing Service, U. S. Department of Agriculture, conducted a series of tests during the summer of 1956.

Sixteen tests were made in July, August, and September 1956 on trailer shipments between Smithfield, N. C., and Baltimore, Md. Two trailers traveled together in each test trip. The hogs in one trailer were not sprinkled, while the hogs in the other trailer were sprinkled for 21 minutes before departure from the shipping point and 4 times en route for periods of 10 minutes each.

Although the weather was unusually cool in the mid-Atlantic Coast States during the summer of 1956, and only a few hot days were encountered during the tests, 6 dead hogs were found in the unsprinkled trailer during the 16 tests, or an average of 0.38 dead hogs per load, while the sprinkled trailer had none. The transit shrink--loss of weight en route--was smaller for the sprinkled hogs than for the unsprinkled hogs. Also, the hot slaughtered yield--weight of meat after slaughter--was greater for the sprinkled hogs than for the unsprinkled hogs. Following is a comparison of the average differences per trailerload:

Transit shrink

Unsprinkled hogs	3.30% or	724 pounds
Sprinkled hogs	2.27% or	498 pounds
Difference	1.03% or	226 pounds

Hot slaughtered yield

Sprinkled hogs	79.37% or	17,429 pounds
Unsprinkled hogs	78.90% or	17,326 pounds
Difference	.47% or	103 pounds

While 16 tests are not considered to be sufficient to prove conclusively the merits of a sprinkling system, the results of the tests are regarded as significant, and therefore are made available in this interim report.

In September 1956, a trailer other than the two test trailers was outfitted with a sprinkler system using plastic "lawn-soaker" garden hose,

instead of galvanized pipe, for the sprinkler headers. The system cost, installed, approximately $35. This equipment appeared to give a better spray pattern than the galvanized pipes. After 3 months of operation, this "soaker hose" system was examined, and it showed no damage from the hogs and no other deterioration.

The double-deck trailers at Smithfield were used exclusively for hauling live hogs. Therefore, it was not necessary that the top deck be removable, as would be the case when cattle and some other cargoes are hauled. Accordingly, the spray header for the lower deck was fastened permanently to the underside of the top deck. It would be necessary to devise a different sprinkler system for those double-deck trailers which have a removable top deck for hauling cattle or other material. Additional tests will be made in the summer of 1957 to evaluate further the benefits of spray cooling of hogs in transit.

TESTS OF A SPRINKLER SYSTEM FOR HOT-WEATHER HAULING OF LIVE HOGS IN TRUCK-TRAILERS

By Robert F. Guilfoy, Jr.
Marketing Research Division
Agricultural Marketing Service

INTRODUCTION

The physiological makeup of hogs is such that they become seriously distressed in hot weather, especially when the temperature is above 90^0 F. Death losses during the movement of hogs to market are common during the summer. One reason for this is the fact that hogs can perspire only through the snout, and not through the skin as do many other animals. Another reason is the greater amount of fat on hogs than on other animals.

The effect of warm weather is greatest when hogs are crowded together, as they often are in a livestock trailer or railroad car during the haul to market or to the packinghouse. Transit shrink--the loss of weight en route--and the number of hogs arriving dead at destination are believed to be greater in summer than in winter. During 1955, the estimated live value of hogs arriving dead at U. S. markets was more than $4,000,000. 1/ Carcasses of hogs that died in transit, being unfit for food, have little or no sale value.

The use of water during transit to help cool the hogs is not new. One method is use of a hose by the driver at his stops to wet down the bedding on each deck of the trailer. This is done by directing a stream of water into the trailer. There is widespread doubt that this method is used enough and that, when used, it gives a good distribution of the water. Further, a direct stream of water from a hose onto a hog may adversely affect the hog, especially if it is in distress because of overheating. A spray-cooling system, such as that described in this report, gives a better distribution of the water as well as a fine spray.

In an effort to reduce hog deaths and transit shrink, a hog marketing company in Smithfield, N. C., in 1955 installed in its trailers a simple, low-cost sprinkler system to spray-cool the hogs. The hogs are sprinkled after loading and at approximately 2-hour intervals during a trip. With the cooperation of the shipper and receiver, the U. S. Department of Agriculture conducted tests to evaluate the effectiveness of the system.

1/ "Livestock Conservation Handbook, 1955," published by Livestock Conservation, Inc., 405 Exchange Building, Chicago 9, Ill.

THE SPRINKLER SYSTEM

Figure 1 shows the general arrangement of the sprinkler system. The truck driver carried in the tractor cab a 25-foot length of 5/8-inch garden hose. This hose was taken from the cab at each stop. One end was attached to a water tap and the other to the sprinkler system at the left front side of the trailer. The permanent piping on the trailer then divided the incoming water between the top and bottom decks. The spray header on each deck was a straight length of ½-inch galvanized pipe located in the center of the trailer and fastened to the deck ceilings. Holes 5/64 of an inch in diameter were drilled in the pipe at intervals of 16 inches along each side. Each spray header ran the length of the trailer.

Details of the piping installed on the trailer are given in figures 2, 3, and 4. A 10-inch length of hose remains fastened to the system to make it easier for the driver to attach the 25-foot length of portable hose. The valve in each branch of piping allows the driver to adjust the amount of spray on each deck. Normally the valves are fully open, except where water pressure is high. In such cases, it is necessary to partially close the valves to prevent spray from coming through the slatted sides of the trailer. Estimated total cost of this system, installed, is $75 per trailer.

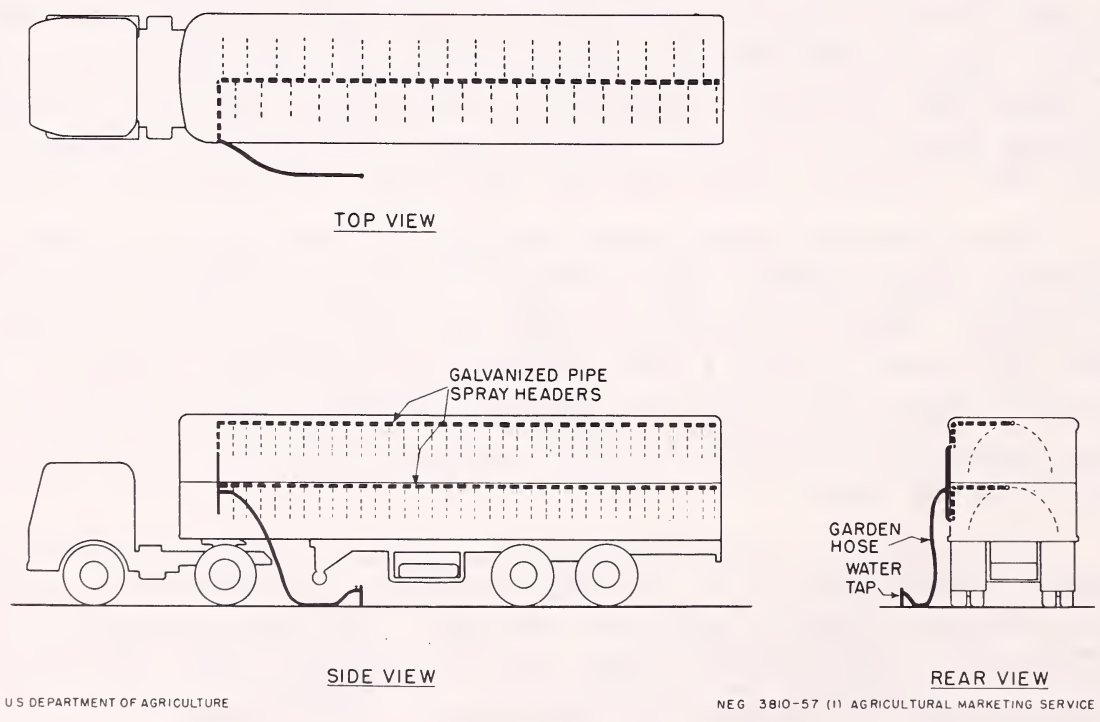


Figure 1.--General arrangement of sprinkler system on the trailer.

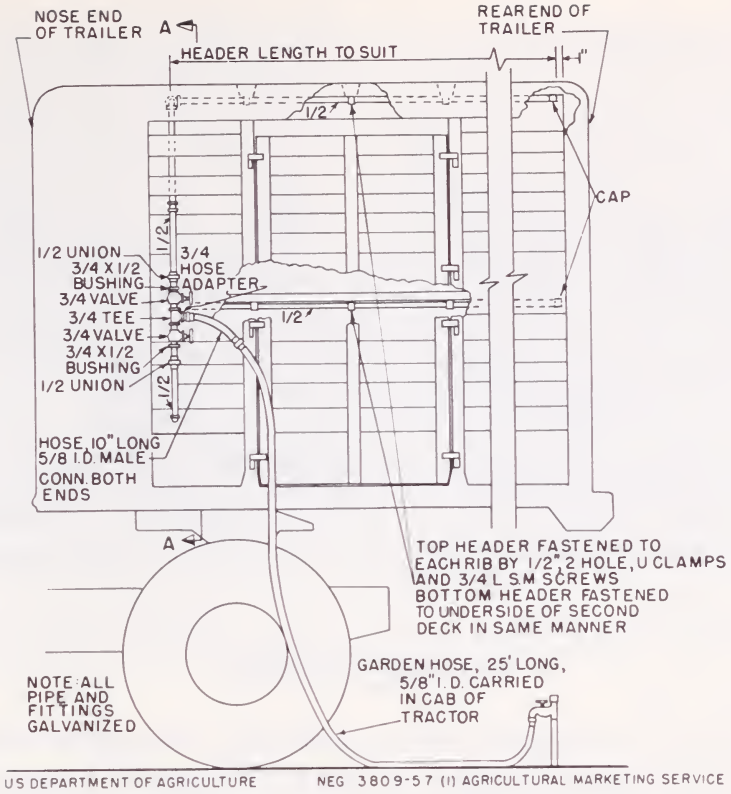

NOSE END OF TRAILER
A
REAR END OF TRAILER
HEADER LENGTH TO SUIT
1"
1/2
CAP
1/2 UNION
3/4 X 1/2 BUSHING
3/4 VALVE
3/4 TEE
3/4 VALVE
3/4 X 1/2 BUSHING
1/2 UNION
3/4 HOSE ADAPTER
HOSE, 10" LONG 5/8 I.D. MALE CONN. BOTH ENDS
TOP HEADER FASTENED TO EACH RIB BY 1/2" 2 HOLE, U CLAMPS AND 3/4 L S.M. SCREWS
BOTTOM HEADER FASTENED TO UNDERSIDE OF SECOND DECK IN SAME MANNER
GARDEN HOSE, 25' LONG, 5/8" I.D. CARRIED IN CAB OF TRACTOR
NOTE: ALL PIPE AND FITTINGS GALVANIZED
US DEPARTMENT OF AGRICULTURE
NEG. 3809-57 (1) AGRICULTURAL MARKETING SERVICE

Figure 2.--Details of piping in the sprinkler system.

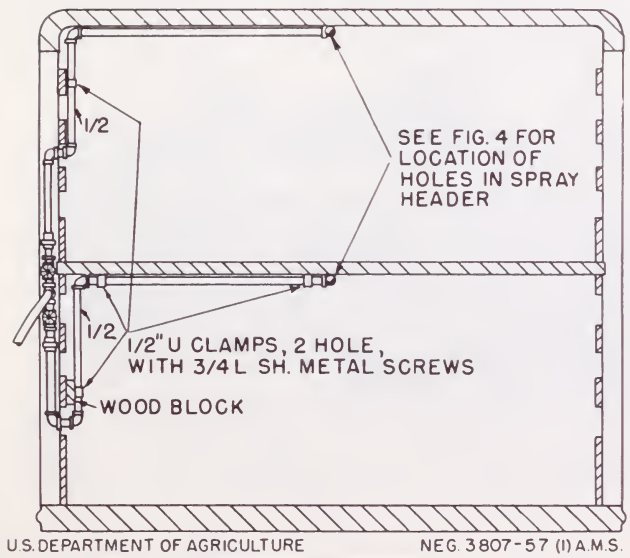

1/2
SEE FIG. 4 FOR LOCATION OF HOLES IN SPRAY HEADER
1/2
1/2" U CLAMPS, 2 HOLE, WITH 3/4 L SH. METAL SCREWS
WOOD BLOCK
U.S. DEPARTMENT OF AGRICULTURE
NEG. 3807-57 (1) A.M.S.

Figure 3.--Cross section of A-A of figure 2.

THE TEST TRAILERS

Figures 5 and 6 show test trailers A and B, respectively, which traveled together on each of the 16 test runs between Smithfield, N. C., and Baltimore, Md. The two trailers were not specially made, but rather were of the type generally used for transporting live hogs. Each trailer was 30 feet long, double-decked, had slatted sides, slatted rear end, and 4 rectangular vents (2 for each deck) in the nose of the trailer.

AIR TEMPERATURE RECORDERS

Air temperatures both inside and outside the trailers were obtained in transit by the use of

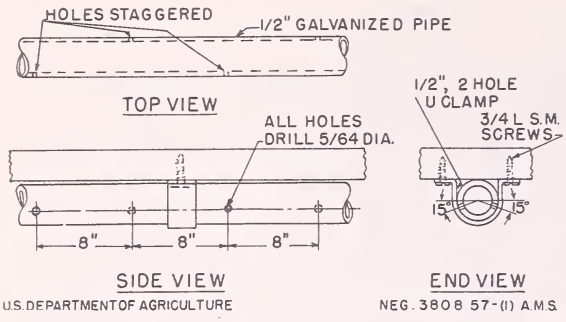
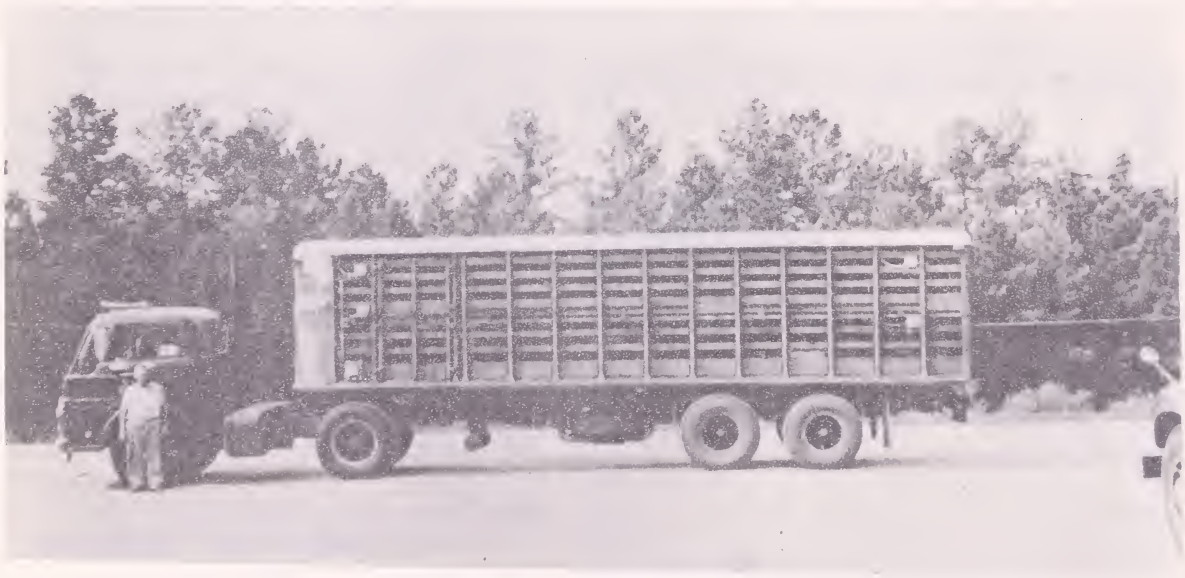


Figure 4.--Location of holes in spray header.

air temperature recorders. The positions of the recorders on the trailers are shown in figure 7. Each trailer had 4 recorders, with 2 bulb mountings on each deck ceiling, 1 at a point 5 feet from the front, the other 5 feet from the rear of the trailer. In addition, trailer A had a fifth recorder on the left front side, connected to a temperature bulb mounted under a protective shelf high on the left corner of the trailer nose, which recorded outside (ambient) air temperatures. To protect the equipment from damage by the hogs, each interior sensing bulb was enclosed in an expanded metal cage, and the tubing from the bulb to the recorder was enclosed in a flexible metal conduit. A polyethylene cover was placed over each recorder to protect it from the weather.

THE TEST PROCEDURE

The objective of the tests was to evaluate the effectiveness of the sprinkler system measured in terms of hog shrinkage in transit, death losses, and hot slaughtered dressed yield. Two test trailers--A and B--traveled together, and made each stop together, during the trip from Smithfield



NEG. BN-3737

Figure 5.--Trailer "A" used in the tests.

NEG. BN-3742

Figure 6.--Trailer "B" used in the tests.

to Baltimore. The distance from shipping point to destination was 330 miles and the average trip time was 11 hours and 20 minutes. The hogs on one trailer received no sprinkling, while the hogs on the other were sprinkled 5 times--once for 21 minutes immediately after loading at Smithfield, and 4 times en route to Baltimore at approximately 2-hour intervals, for periods of 10 minutes.

To compensate for possible effects of such factors as differing driver habits, types of tractors, trailer structural characteristics, etc., sprinkling in the trailers was alternated. Trailer A was the "sprinkled" trailer and trailer B was the "unsprinkled" trailer for the first 10 tests, and during the next 6 tests, trailer A was the "unsprinkled" trailer and B was the "sprinkled" trailer. Plans had called for 20 tests during the summer, but cool weather forced a halt after 16 test trips.

For each test trailer, the hogs were weighed immediately before loading at Smithfield and again after unloading at Baltimore. Test trips were made during the daytime and hogs were slaughtered the following morning. The hot slaughtered weight of the hogs on the meat rail was obtained for each load.

The floors of each trailer were covered with straw for the first test. The use of straw resulted in a slippery floor for the hogs and all remaining tests were made with sawdust floor covering, which provided a better footing.

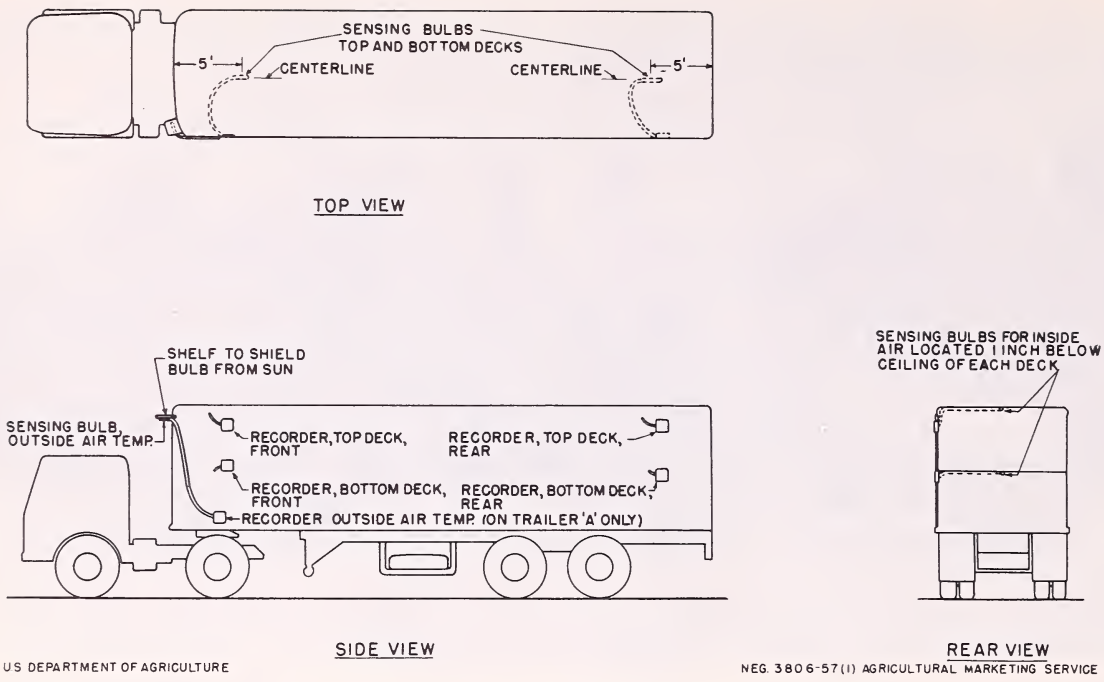


Figure 7.--Location of recorders and points at which inside and outside air temperatures were taken.

Air temperature charts were placed in each recorder at Smithfield and were removed at Baltimore.

Figures 8, 9, and 10 show the procedure followed in sprinkling the hogs at one of the stops en route. In figure 8, the driver has connected the portable hose to the sprinkling system on the trailer and to the outside water faucet at the truck stop. In figure 9, the driver turns one of the valves on the sprinkling system so as to adjust the amount of spray inside the trailer. Figure 10 shows the hogs being sprinkled inside the trailer. It was observed that, after the sprinkling, the cooling effects of the water tended to quiet the hogs and in most cases resulted in their lying down.

TEST RESULTS

Over 85 percent of the hogs used in the tests were in the 180-240 pound weight range. Following is the percentage of each weight range of hogs used during the 16 tests:

Weight range Pounds	Unsprinkled trailer Percent	Sprinkled trailer Percent
180 to 240	85.3	86.0
160 to 180	9.0	5.7
240 to 270	2.3	3.8
All others	3.4	4.5
Total	100.0	100.0

Data obtained from the 16 tests are shown in tables 1 and 2. There was no indication that sprinkling influenced the amount of bruising or the number of hogs condemned after slaughter. Therefore, the hot slaughtered weights used were those obtained before removal of any bruised meat or condemned hogs. The average weight of meat subsequently removed for bruises per trailerload, was 37.8 pounds for the unsprinkled load and 31.9 pounds for the sprinkled load. The average weight of meat from condemned hogs subsequently removed, per trailerload, was 35.4 pounds for the unsprinkled load and 69.5 pounds for the sprinkled load.

NEG. BN-3740

Figure 8.--Trailer with portable hose connected for sprinkling during one of the tests.

NEG. BN-3735

Figure 9.--Driver turning one of the valves to adjust the amount of spray inside the trailer.

NEG. BN-3738

Figure 10.--View inside the trailer as hogs were being sprayed.

Table 1.--Weight of hogs in 2 trailers (1 unsprinkled, 1 sprinkled) when loaded, unloaded, and after slaughter in 16 shipments from Smithfield, N. C., to Baltimore, Md., July-September 1956

Date	Test No.	Hogs													
		Live weight when				Percentage of shrinkage in transit 1/		Hot slaughtered weight		Percentage hot yield 2/		Hogs on trailer		Dead carcasses unloaded	
		Loaded		Unloaded											
		Unsprinkled	Sprinkled	Unsprinkled	Sprinkled	Unsprinkled	Sprinkled	Unsprinkled	Sprinkled	Unsprinkled	Sprinkled	Unsprinkled	Sprinkled	Unsprinkled	Sprinkled
1956		Pounds	Pounds	Pounds	Pounds	Percent	Percent	Pounds	Pounds	Percent	Percent	Number	Number	Number	Number
July 8:	1	22,395	22,450	21,470	21,870	3/ 4.13	2.58	17,664	17,838	78.87	79.46	112	114	1	0
July 11:	2	23,290	21,930	22,600	21,340	2.96	2.69	18,539	17,482	79.60	79.72	114	104	0	0
July 15:	3	19,415	18,570	18,765	18,075	3.35	2.67	15,124	14,753	77.90	79.45	101	100	0	0
July 17:	4	23,340	22,610	22,695	22,100	2.76	2.26	18,422	17,580	78.93	77.75	126	122	0	0
July 19:	5	20,235	20,080	19,765	19,680	2.32	1.99	16,341	16,101	80.76	80.18	104	101	0	0
July 24:	6	22,525	22,725	21,835	22,065	3.06	2.90	17,780	17,972	78.93	79.08	124	115	0	0
July 29:	7	19,780	19,935	19,085	19,465	3.51	2.36	15,643	15,755	79.08	79.03	101	96	0	0
Aug. 1:	8	18,440	18,310	17,890	17,780	2.98	2.89	14,380	14,368	77.98	78.47	91	87	0	0
Aug. 9:	9	24,540	24,700	23,480	24,235	4.32	1.88	19,594	19,726	79.85	79.86	125	119	0	0
Aug. 14:	10	24,825	24,805	23,060	24,220	3/ 7.11	2.36	19,288	19,845	77.70	80.00	118	118	4	0
Aug. 19:	11	18,500	18,375	18,175	18,000	1.76	2.04	14,366	14,511	77.65	78.97	98	97	0	0
Aug. 21:	12	20,195	20,110	19,795	19,695	1.98	2.06	15,856	15,750	78.51	78.32	106	103	0	0
Aug. 28:	13	25,380	25,325	24,680	24,725	2.76	2.37	19,975	20,132	78.70	79.49	128	130	0	0
Aug. 30:	14	23,675	23,860	22,590	23,290	3/ 4.58	2.39	18,375	18,995	77.61	79.61	120	117	1	0
Sept. 4:	15	24,715	24,485	24,135	24,045	2.35	1.80	19,812	19,535	80.16	79.78	122	117	0	0
Sept. 6:	16	23,105	23,080	22,655	22,780	1.95	1.30	18,403	18,524	79.65	80.26	117	117	0	0
Average:		22,147	21,959	21,417	21,460	3.30	2.27	17,473	17,429	78.90	79.37	112.94	109.81	0.38	0

1/ $\frac{\text{Live weight loaded minus live weight unloaded}}{\text{Live weight loaded}} \times 100$

2/ $\frac{\text{Hot slaughtered weight}}{\text{Live weight loaded}} \times 100$

3/ Includes dead hogs.

Table 2.--Average outside and inside air temperatures of 2 trailers (1 unsprinkled, 1 sprinkled) during 16 shipments of hogs from Smithfield, N. C., to Baltimore, Md., July-September 1956

Date	Test number	Outside air	Average temperatures 1/ Inside trailer: Bottom deck 2/ Unsprinkled	Bottom deck 2/ Sprinkled	Top deck 2/ Unsprinkled	Top deck 2/ Sprinkled	Average of both decks Unsprinkled	Average of both decks Sprinkled
1956			°F.	°F.	°F.	°F.	°F.	°F.
July 8	1	83.2	84.9	86.0	86.3	80.9	85.6	83.5
July 11	2	84.0	83.1	79.3	83.7	77.9	83.4	78.6
July 15	3	81.0	84.3	79.2	84.6	78.3	84.5	78.8
July 17	4	70.1	76.8	72.4	76.4	70.5	76.6	71.5
July 19	5	76.7	80.5	76.0	80.7	76.9	80.6	76.5
July 24	6	78.0	80.2	81.7	78.4	80.1	79.3	80.9
July 29	7	71.3	79.4	75.1	75.8	73.1	77.6	74.1
Aug. 1	8	78.9	86.5	82.5	81.9	80.8	84.2	81.6
Aug. 9	9	80.8	87.0	83.2	87.1	80.4	87.1	81.8
Aug. 14	10	72.9	87.1	83.6	85.1	79.9	86.1	81.7
Aug. 19	11	93.5	91.8	86.3	88.4	86.9	90.1	86.6
Aug. 21	12	67.3	69.9	63.0	66.7	66.0	68.3	64.5
Aug. 28	13	83.6	89.4	87.0	87.8	86.0	88.6	86.5
Aug. 30	14	93.6	94.5	90.1	93.1	89.6	93.8	89.8
Sept. 4	15	83.6	84.9	82.1	83.8	82.8	84.4	82.4
Sept. 6	16	88.3	84.0	80.8	83.6	81.5	83.8	81.1
Average		80.4	84.0	80.5	82.7	79.5	83.4	80.1

1/ Average of half-hour interval readings taken from temperature recordings.

2/ Average of front and rear temperature readings.

Although the weather was relatively cool (80.4° F. average), there were 6 dead hogs in the unsprinkled trailer and no dead hogs in the sprinkled trailer during the 16 tests. The transit shrink was greater for the unsprinkled hogs than for the sprinkled hogs on 14 of the 16 tests. The percentage of hot yield was greater for the sprinkled hogs than for the unsprinkled hogs on 11 of the 16 tests.

The methods of calculating the average transit shrink and hot slaughtered yield differences per trailer between the sprinkled versus unsprinkled hogs are shown in tables 5 and 6, respectively, in the Appendix. The differences are expressed both in percentages and in pounds. Since the

average weights per trailerload at origin were not identical (22,147 pounds and 21,959 pounds), weight differences are calculated on the basis of the weight of the average load of sprinkled hogs (21,959 pounds). Following is a comparison of the average differences per trailerload:

	Percent	Pounds
1. Transit shrink		
a. Unsprinkled hogs:		
Loss of weight en route of those hogs which arrived alive at destination	2.97	652
Weight of those hogs which arrived dead at destination	.33	72
Total loss of weight en route	3.30	724
b. Sprinkled hogs:		
Loss of weight en route of those hogs which arrived alive at destination	2.27	498
Weight of those hogs which arrived dead at destination (none)	0	0
Total loss of weight en route	2.27	498
c. Difference in loss of weight en route of the sprinkled hogs as compared to the unsprinkled hogs (a - b)	1.03	226
2. Hot slaughtered yield		
a. Sprinkled hogs:		
Weight of meat on the rail after slaughter	79.37	17,429
b. Unsprinkled hogs:		
Weight of meat on the rail after slaughter	78.90	17,326
c. Difference in weight of meat on the rail after slaughter of the sprinkled hogs as compared to the unsprinkled hogs (a - b)	.47	103

The hogs were observed at each stop en route and those that were sprinkled appeared to be the more comfortable. They were quieter, reclined more, and foamed less at the mouth than the unsprinkled hogs.

The spray system appears to cool the hogs in three different ways. First, the spray onto the animals gives a cooling effect. Second, the spray system wets down the sawdust and the animals are cooled by lying down on this water-soaked bedding. Third, the air inside the sprinkled trailer averaged 3.4° F. cooler than the air inside the unsprinkled trailer (83.4-80.0).

It will also be observed that bottom-deck temperatures were generally higher than those found in the top deck (the average difference was 1.3° in the unsprinkled and 1.0° in the sprinkled trailer). No doubt the number, size, and weight of the animals in the different decks had some influence on this result. Although the weights loaded in each deck were not obtained, there were usually a few more hogs loaded in the lower than in the upper decks. Of the 6 dead hogs, 4 were in the bottom deck and 2 were in the top deck.

Tables 3 and 4 provide more details of outside and inside trailer temperatures and the weights of hogs in each test load. On only 2 days were the average temperatures inside the unsprinkled trailer lower than those outside (by 0.6° on an 84-degree day and 2.4° on a 93.5-degree day). In the sprinkled trailer, inside trailer temperatures were lower than those outside in 8 of the 16 tests, being generally lower when the ambient temperature was higher than 80° F. and higher when it was below that point.

Table 3.--Temperatures and their relationship to weight of hogs loaded in the unsprinkled trailer

Test number	Average temperatures: Outside air (ambient)	Inside trailer: Average both decks	Above ambient	Below ambient	Live weight when loaded
	°F.	°F.	°F.	°F.	Pounds
1	83.2	85.6	2.4		22,395
2	84.0	83.4		0.6	23,290
3	81.0	84.5	3.5		19,415
4	70.1	76.6	6.5		23,340
5	76.7	80.6	3.9		20,235
6	78.0	79.3	1.3		22,525
7	71.3	77.6	6.3		19,780
8	78.9	84.2	5.3		18,440
9	80.8	87.1	6.3		24,540
10	72.9	86.1	13.2		24,825
11	93.5	90.1		2.4	18,500
12	67.3	68.3	1.0		20,195
13	83.6	88.6	5.0		25,380
14	93.6	93.8	.2		23,675
15	83.6	84.4	.8		24,715
16	88.3	83.8	4.5		23,105

Table 4.--Temperatures and their relationship to weight of hogs loaded in the sprinkled trailer

Test number	Average temperatures: Outside air (ambient)	Inside trailer: Average both decks	Inside trailer: Above ambient	Inside trailer: Below ambient	Live weight when loaded
	°F.	°F.	°F.	°F.	Pounds
1	83.2	83.5	0.2		22,450
2	84.0	78.6		5.4	21,930
3	81.0	78.8		2.2	18,570
4	70.1	71.5	1.4		22,610
5	76.7	76.5		.2	22,080
6	78.0	80.9	2.9		22,725
7	71.3	74.1	2.8		19,935
8	78.9	81.6	2.7		18,310
9	80.8	81.8	1.0		24,700
10	72.9	81.7	8.8		24,805
11	93.5	86.6		6.9	18,375
12	67.3	64.5		2.8	20,110
13	83.6	86.5	2.9		25,325
14	93.6	89.8		3.8	23,860
15	83.6	82.4		1.2	24,485
16	88.3	81.1		7.2	23,080

On the warmest day (93.6° F. ambient), there were 4 dead hogs in the unsprinkled trailer, carrying a load of 23,675 pounds. On a cool day (72.9° F. ambient), with the heaviest load of hogs in the series of tests of the sprinkled trailer, 24,805 pounds, average inside temperature exceeded the outside temperature by 8.8°, the highest difference in the 16 tests of that trailer. On another hot day (93.5° F.), with a load weighing only 18,375 pounds, the temperature inside the sprinkled trailer was 6.9° lower. On the same day, with another light load, 18,500 pounds, in the unsprinkled trailer, inside trailer temperatures averaged 2.4° lower than outside. On the only other day when inside temperatures in this trailer averaged lower than outside, the ambient temperature was 84° F., the weight of hogs loaded was 23,290 pounds, and the temperature difference was 0.6°. It is unsafe to generalize from the few examples cited here, but they do support the general belief of stockmen and livestock haulers that higher temperatures, and consequently greater danger of death losses from overheating during the warm months, will be found in heavy loads.

EXPERIMENTAL SOAKER HOSE SPRAY SYSTEM

The sprinkler system on the trailers tested had one disadvantage. Through trial-and-error experiments made when the system was designed, it had been found that with 5/64-inch diameter holes spaced less than 16 inches apart, the water pressure at transit stops was not strong enough to eject the spray at the far end of the pipe, toward the rear of the trailer. Therefore, it was necessary to space the 5/64-inch diameter holes 16 inches apart on each side of the pipe. It was observed during the tests that the single jets of water spurting from holes so far apart did not reach all of the hogs, and that the wetted area of those it did strike was small.

Accordingly, toward the end of the series of tests a new system was devised, using a length of plastic "lawn soaker" hose instead of the metal pipe header. The hose was ½-inch in inside diameter, with tiny holes over its entire surface, which allowed it to spray in all directions. This system was installed in another trailer in use at Smithfield. Figures 11 and 12 show the arrangement of the system outside and inside the trailer, respectively.

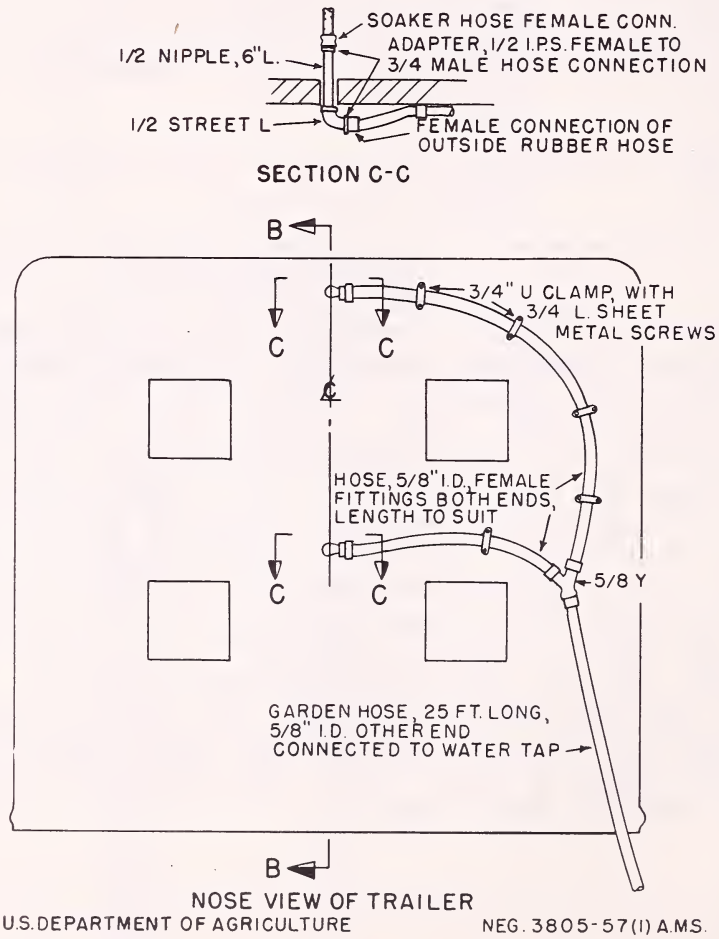

SOAKER HOSE FEMALE CONN.
ADAPTER, 1/2 I.P.S. FEMALE TO 3/4 MALE HOSE CONNECTION
1/2 NIPPLE, 6" L.
1/2 STREET L
FEMALE CONNECTION OF OUTSIDE RUBBER HOSE
SECTION C-C
B
C
C
3/4" U CLAMP, WITH 3/4 L. SHEET METAL SCREWS
HOSE, 5/8" I.D. FEMALE FITTINGS BOTH ENDS, LENGTH TO SUIT
5/8 Y
GARDEN HOSE, 25 FT. LONG, 5/8" I.D. OTHER END CONNECTED TO WATER TAP
NOSE VIEW OF TRAILER
U.S. DEPARTMENT OF AGRICULTURE
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Figure 11.--Outside arrangement of "soaker" hose sprinkler system.

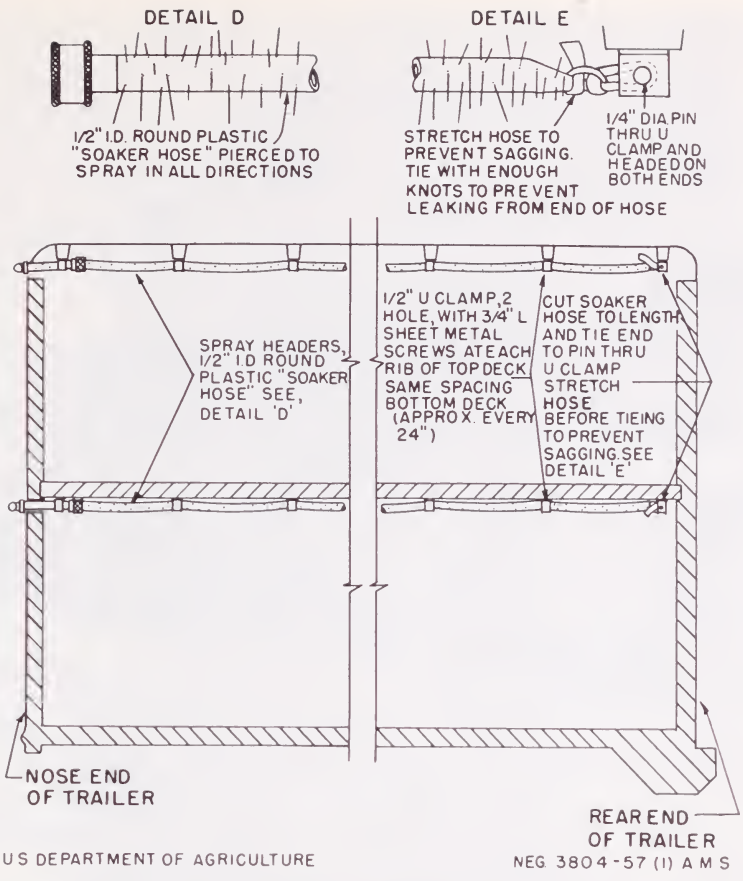
DETAIL D
1/2" I.D. ROUND PLASTIC "SOAKER HOSE" PIERCED TO SPRAY IN ALL DIRECTIONS
DETAIL E
STRETCH HOSE TO PREVENT SAGGING. TIE WITH ENOUGH KNOTS TO PREVENT LEAKING FROM END OF HOSE
1/4" DIA PIN THRU U CLAMP AND HEADED ON BOTH ENDS
SPRAY HEADERS, 1/2" I.D ROUND PLASTIC "SOAKER HOSE" SEE, DETAIL 'D'
1/2" U CLAMP, 2 HOLE, WITH 3/4" L SHEET METAL SCREWS AT EACH RIB OF TOP DECK SAME SPACING BOTTOM DECK (APPROX. EVERY 24")
CUT SOAKER HOSE TO LENGTH AND TIE END TO PIN THRU U CLAMP STRETCH HOSE BEFORE TIEING TO PREVENT SAGGING SEE DETAIL 'E'
NOSE END OF TRAILER
REAR END OF TRAILER
U S DEPARTMENT OF AGRICULTURE
NEG. 3804-57 (1) A M S

Figure 12.--Section B-B of figure 11, showing inside arrangement of "soaker" hose sprinkling system.

This trailer was not used in the tests for which data have been shown, because it was not considered desirable to introduce a variable in the series of tests already under way.

Figures 13, 14, and 15 show the experimental spray system in operation. In figure 13, the portable hose is connected to the sprinkler system on the trailer and to an outside water tap. Figure 14 is a closeup view of the nose of the trailer, while figure 15 is a view of the spray produced by the plastic "soaker" hose header inside the trailer. The blurred effect of figure 15 is due to the water spray and fine mist produced by the "soaker" hose.

This experimental system, installed, cost approximately $35 and appeared to give a finer and better distributed water spray than the galvanized pipe system. It is very simple to install. After 3 months of operation, the trailer was examined and there was no damage from hogs and no other deterioration of the sprinkling system. The only part of the system that the hogs might damage eventually is the plastic hose headers inside the trailer.

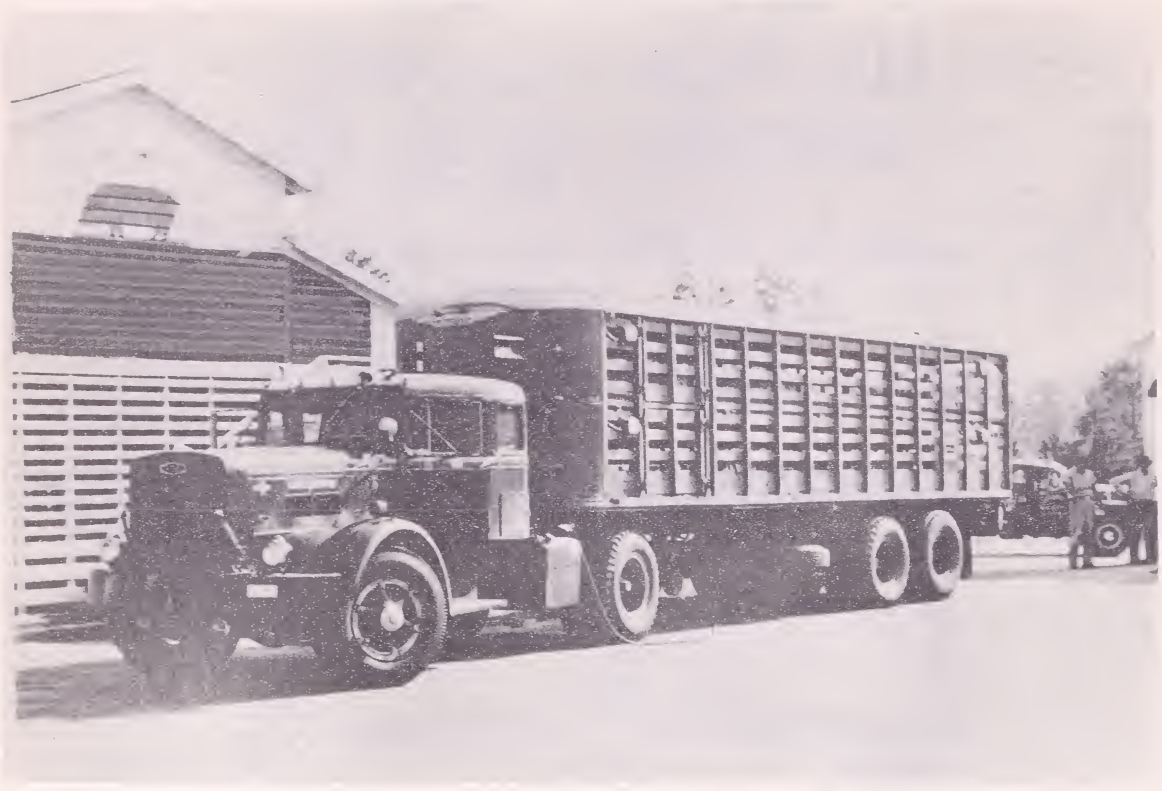

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Figure 13.--Portable hose connected to trailer with experimental spray system.

However, the soaker hose is overhead and, as far as is known, the hogs have made no attempt to tear it down. A replacement soaker hose costs about $1.50.

CONCLUSIONS

The tests were conducted during relatively cool weather--80.5° F. average outside air temperature during the tests. It is reasonable to assume that spraying of hogs would be of greater benefit during warmer weather.

The results of these tests indicate that water spray cooling of hogs in transit may be of material benefit in reducing death loss and transit shrink, and in increasing hot yield. The average advantage figures obtained in these tests are not conclusive, as 16 is not a sufficient number of tests to prove definitely the merits of sprinkling.

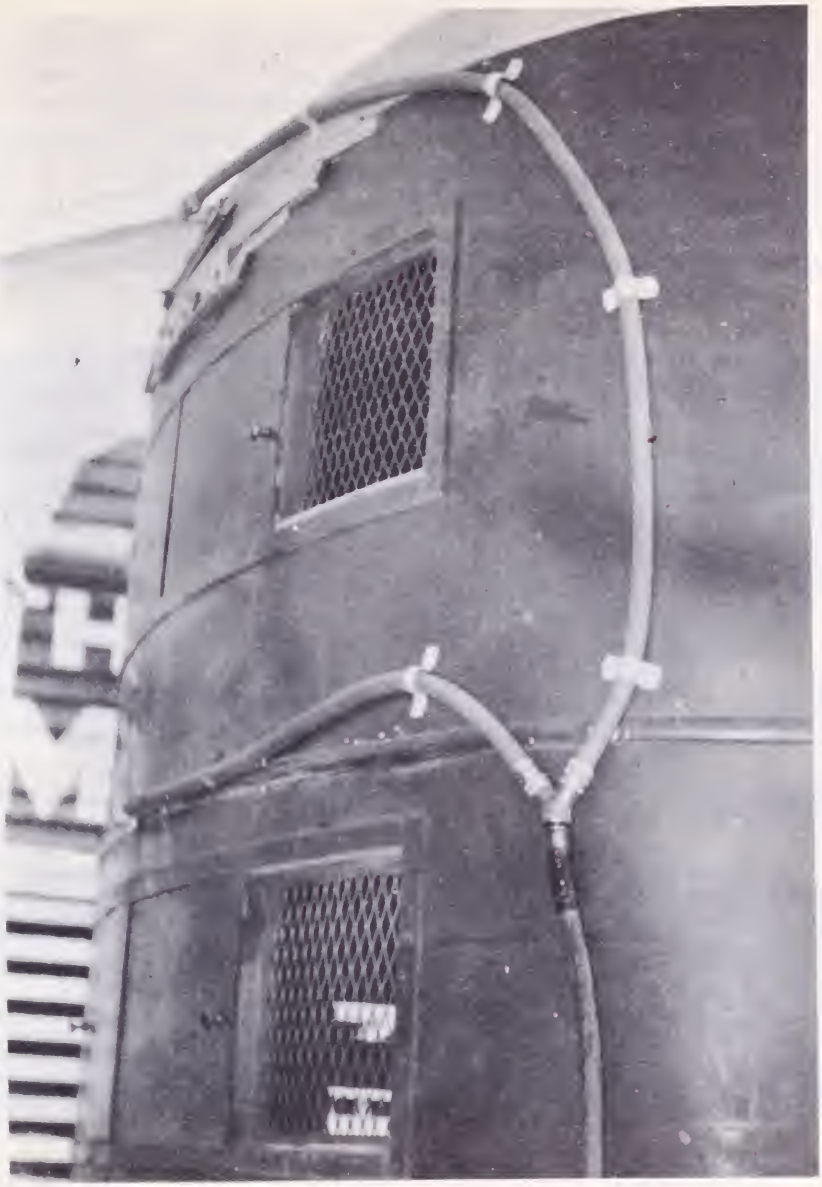

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Figure 14.--Nose view of trailer with experimental spray system.

The experimental "soaker hose" installation used on a trailer over a period of 3 months appears to provide a better distribution of the spray, is inexpensive, and easy to install. An additional feature for this system might be a metal box fixed to the nose of the trailer, in which the 25-foot length of outside hose could be rolled up and stored. This addition would make it unnecessary to disconnect the hose each time after use for storage in the tractor cab.

The two sprinkling systems (pipe and "soaker hose") described in this report were installed in double-deck trailers which hauled live hogs exclusively. Therefore, the spray header for the lower deck was fastened permanently to the underside of the top deck. It would be necessary to devise a different spray system for those trailers which have a removable top deck for hauling cattle or other cargo. Further research is planned to devise such a system. Extensive tests are scheduled for the summer of 1957 to evaluate further the benefits of spray cooling of hogs in transit.

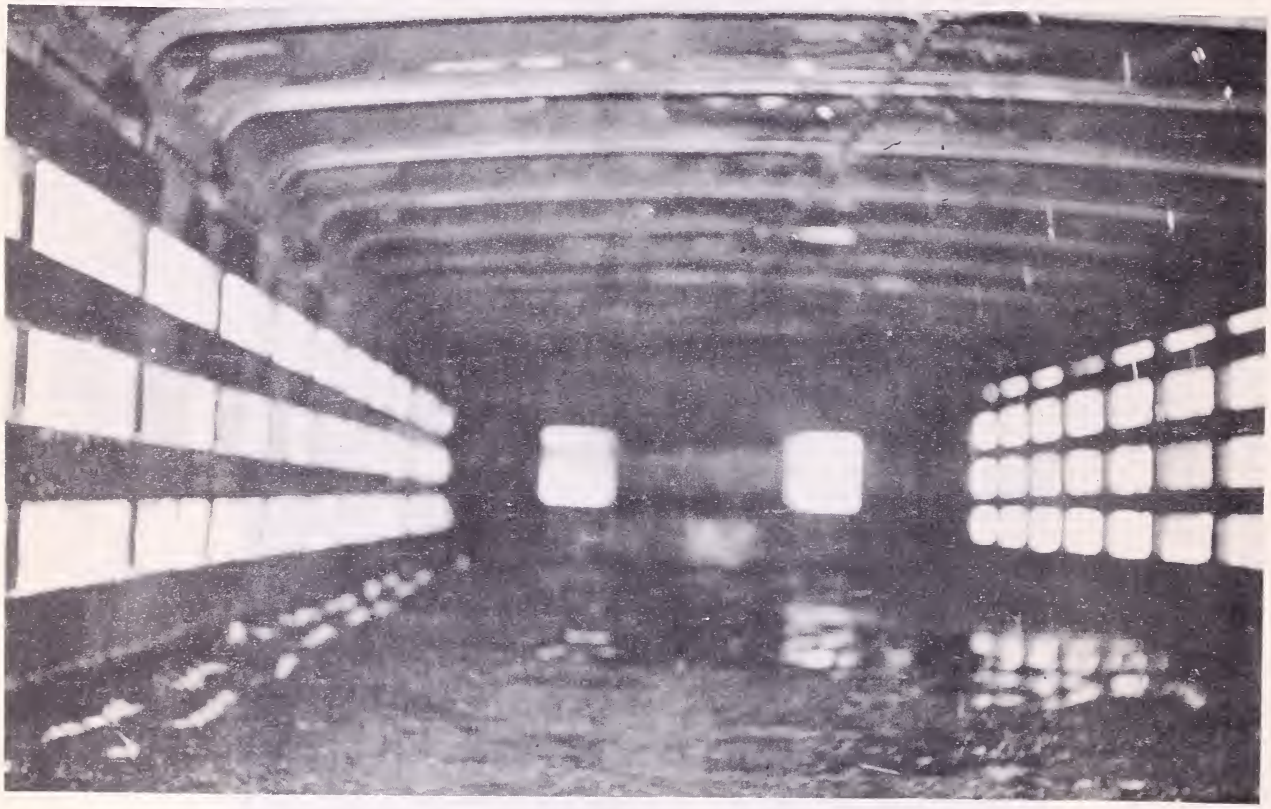

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Figure 15.--View inside trailer (upper deck) showing spray from "soaker" hose header.

APPENDIX

Table 5.--Method of calculating the average transit shrink difference per trailerload between unsprinkled and sprinkled hogs 1/

Item	Calculation	Result	
		Percent	Pounds
Unsprinkled hogs--loss of weight en route of those hogs which arrived alive at destination 2/	$100 - \left[\frac{21,417 \times 100}{22,147 - \left(\frac{.38 \times 22,147}{112.94}\right)}\right]$	2.97	
	$\frac{2.97 \times 21,959}{100}$		652
Unsprinkled hogs--weight of those hogs which arrived dead at destination	$\frac{.38 \times 100}{112.94}$	0.33	
	$\frac{.33 \times 21,959}{100}$		72
Unsprinkled hogs--total loss of weight en route	$\frac{2.97 + .33}{652 + 72}$	3.30	724
Sprinkled hogs--loss of weight en route of those hogs which arrived alive at destination	1/	2.27	
	$\frac{2.27 \times 21,959}{100}$		498
Sprinkled hogs--weight of those hogs which arrived dead at destination	None	0	
	None		0
Sprinkled hogs--total loss of weight en route	$\frac{2.27 + 0}{498 + 0}$	2.27	498
Differences in total loss of weight en route of the sprinkled hogs as compared to the unsprinkled hogs	3.30 - 2.27	1.03	
	724 - 498		226

1/ Calculation figures taken from averages shown in table 1.

2/ Data on unsprinkled loads shown in table 1 include animals found dead at destination. To arrive at the transit shrink of live hogs, this calculation was made.

Table 6.--Method of calculating the average hot slaughtered yield difference per trailerload between sprinkled and unsprinkled hogs 1/

Item	Calculation	Result	
		Percent	Pounds
Sprinkled hogs--weight of meat on the rail after slaughter	1/	79.37	
	$\frac{79.37 \times 21,959}{100}$		17,429
Unsprinkled hogs--weight of meat on the rail after slaughter	1/	78.90	
	$\frac{78.90 \times 21,959}{100}$		17,326
Difference in weight of meat on the rail after slaughter of the sprinkled hogs as compared to the unsprinkled hogs	79.37 - 78.90	.47	
	17,429 - 17,326		103

1/ Calculation figures taken from average shown in table 1.

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